# Tunable Negative Refraction in Si-Polymer Photonic Crystal Membrane

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We report an extensive theoretical and experimental study on mechanically tunable photonic crystal (PC) membrane composed of Si rods and flexible polymer. The photonic band structure is extremely sensitive to structural changes and thus mechanical tuning provide much greater tunability than electro-optic methods [1]. Based on extensive simulations, we quantitatively defined relationship between the structural parameters and photonic bands. Wide tunability was predicted for both beam steering and sub-wavelength imaging. We fabricated test structures along with ridge waveguides with various incident angles for in-coupling (Fig. 1a). A 1.54 μm laser beam underwent negative refraction with an angle consistent with our simulations (Fig. 1b). To our knowledge, this is the first experimental observation of isotropic negative refraction in a Si-based planar PC structure at optical frequencies. We will present our latest results on various waveguide designs for unambiguous experimental demonstration of sub-wavelength imaging and the integration with MEMS actuators for mechanical tuning.

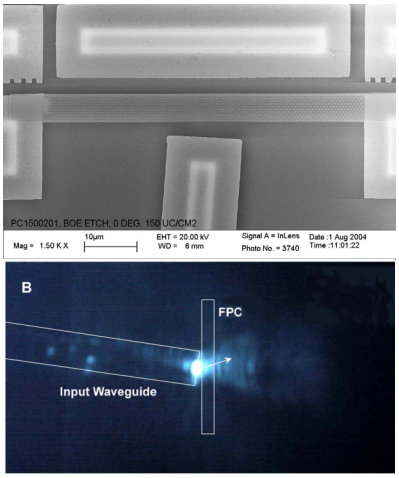


Fig.1 (a) SEM micrograph of the suspended Si-polymer PC membrane and the ridge waveguide for input coupling. (b) Experimental image of light scattered from a 6° angled input waveguide coupled into a Si-polymer PC region. The arrow indicates the direction of light propagation numerically obtained from the simulations.

[1] W. Park and J.-B. Lee, *Appl. Phys. Lett.* **85**, 4845 (2004)